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ABSTRACT

This paper describes the development of the Web site for a graduate course in statistics and measurement, and offers recommendations for future continued development of this and other Web-based courses within the field of education. The site was initially designed to supplement the course as it was currently being taught. An overview of the basic structure of the Web site and how specific units are being converted to be delivered online is presented. As a part of a formative evaluation, students enrolled in the class were surveyed regarding their perceptions of the Web site and how it had contributed to their educational experiences. Although apprehensive at first, student response to the Web site was very positive. (Author)

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The Instructional and Technological Challenges of a Web Based Course in Educational Statistics and Measurement

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

Abstract: This paper describes the development of the web site for a graduate course in statistics and measurement, and offers recommendations for future continued development of this and other web-based courses within the field of education. The site was initially designed to supplement the course as it was currently being taught. An overview of the basic structure of the web site and how specific units are being converted to be delivered online is presented. As a part of a formative evaluation, students enrolled in the class were surveyed regarding their perceptions of the web site and how it had contributed to their educational experiences. Although apprehensive at first, student response to the web site was very positive.

Introduction

In an attempt to tap into a potentially large market, many colleges and universities are now jumping on the bandwagon and restructuring their existing courses to be offered via the Internet. Increasing numbers of students will no doubt be using the Internet more frequently in the future in many aspects of their coursework and in their jobs for research, communication and collaboration. The convenience of taking higher education courses over the Internet will attract many students to earn credits on-line. The number of providers of Internet-based instruction continues to grow as does the number of student desiring nontraditional delivery methods of instruction (Puyear, 1997). Students have the right to expect a high level of quality from web-based courses that they pay for. And instructors are responsible for developing quality web based courses that result in stimulating learning experiences for all students (McGonigle & Eggers, 1998).

In response to the growing trend towards web-based instruction, the Dean of the School of Education at a small upper division university in southeast Texas gave three faculty members the task of exploring how three core courses of the Master's degree program could be delivered via the internet. This was a summer time project initiated as part of a long term goal to deliver the entire School of Education Master's degree program online. Faculty were given the freedom to develop these web-based courses without any requirements or restrictions on what could be accomplished. It was felt that whatever progress could be made during this short time period would provide valuable initial feedback that could be applied to the continued development of these three projects, as well as the further development of other university web-based courses. An instructional designer/developer was assigned to each faculty member on a part-time basis to assist with the technical aspects of the project.

The Course

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One of the three courses to be offered via the Internet is a graduate level course in educational statistics and measurement. This course is required of all master's students in the School of Education, as well as post-baccalaureate students seeking teacher certification. The primary course objective is for the student to acquire an understanding of basic descriptive statistics and the principals of measurement. The course is divided into three content areas: basic descriptive statistics, including levels of measurement, frequency distributions, and measures of central tendency, variability and relationship; principles of measurement, including test construction procedures, item analysis, reliability, and validity; and measurement topics, such as assessment in education, standardized measures of aptitude and achievement, other approaches to assessment, and program evaluation. Prior to this project, efforts to infuse technology into the course included using spreadsheet programs such as *Microsoft Excel* to summarize and analyze data.

Development and Design of the Web Site

Because of the short time period for the project (nine weeks) and the instructor's limited experience using the internet, a decision was made early on to design a site that supplemented the course as it was currently being taught. This provided a base from which specific in-class sessions could then be converted for delivery online. The basic structure for the site was derived from existing web courses that the instructor had browsed. For the instructor with a limited knowledge of the internet, searching for example sites that can be adapted to one's own course can be a valuable starting point. The main idea for the site described here was a hyperlinked course schedule, adapted from the syllabus of a course in multicultural education (http://picce.uno.edu/SS/EDCI4620/SP984620syl.html#Calendar). Based on this concept, a web site was designed that included a main home page and a course schedule with links to individual units. The advantage of this layered approach is that it provides a mechanism for added security once the course is delivered online. Whereas access to the course materials could be limited (password protected) to students who have enrolled in the course, browsers who were interested in the course could still obtain general information about the course content and requirements.

Basic Design

The home page for the course's web site () resembles the course syllabus and provides general information about the course objectives, organization, and evaluation. *Course procedures and polices* are placed on a separate page and linked to the home page. The *Schedule* page, also linked through the home page, provides a tentative class schedule with a list of topics or units for the current semester. Hyperlinks to the individuals units are included on this page. The individual units were based on the materials in the instructor's course pack which included: unit objectives, study guide questions to accompany the reading assignments, quizzes, lecture outlines, in-class activities, and additional resources, such as practice problems and links to other sites. For the first iteration of the web site, not every unit had every element, but the site was built with placeholders for these elements, allowing for easy upgrading at a later date. It is important for a web site to be designed with maintenance in mind, as the web is a dynamic environment and the optimal web design will result from fine-tuning and several iterations (Schlegel, 1996).

Originally, the course was divided into 18 units, essentially one unit per chapter of the course textbook, Thorndike's (1997) *Measurement and evaluation in psychology and education.* The schedule was later revised into 11 units based on the topic rather than the chapter, roughly one unit per class meeting (excluding exams). This resulted in a less cumbersome schedule that could be easily modified from semester to semester and the creation of the appropriate units of instruction for future development of a completely web-based course.

Other components to the site include a resource page which provides links for downloading the course pack, resources for individual units, and other useful material. A *Student Information Form* was added to the home page for students to complete online. This page was also edited after the first iteration to be more generic with less information that would have to be changed each semester. Technical requirements and an *About this Site* page were also added to provide the user with information about how to navigate the site, an important aspect of web sites which is often overlooked. The design also includes a discussion board where students can post questions and comments, although this aspect of the site is not yet operational.

Online Activities

Each unit includes a quiz designed to help the student test his or her comprehension of the reading material. These quizzes were originally administered in class at the beginning of each session During the summer there was one online quiz; all were online by the fall semester. Each quiz consists of five to fifteen objective questions for automatic easy scoring. Students' completed quizzes are scores electronically and the results are emailed to the instructor. The student receives immediate feedback regarding his or her own performance, as well as the correct answers to each item. Although quizzes are scored, a student's grade for this portion of the course is based on the number of quizzes the student attempts, not on the actual quiz grade. This provides the student an incentive to complete the reading assignment but eliminates any possible anxiety associated with taking a quiz. Since many students enrolled in a statistics courses experience something akin to math anxiety, it is important to provide learning experiences that decrease rather than increase students' stress levels.

Once the basic structure of the web site was in place, the instructor and web developer could begin to convert individual units for online delivery. The first to be converted was the unit on test construction. This unit includes guidelines for constructing tests and writing test items. In place of a class lecture, materials to supplement the reading assignment were placed online under *Class Materials* for that unit. The item writing assignment that accompanies this unit was translated to be similar to the online quizzes. There are two parts to the assignment: (a) a set of objective questions that askes the student to evaluate a series of test items, and (b) a set of text blocks for the student to practice writing test items. The assignment was programmed such that the objective items are automatically scored, and then emailed to the instructor for further feedback on the written part.

Future development of the site as a web-based course was an integral part of the design. For example, the *Study Guide Questions* could possibly be converted into an online class discussion area or chat room. The lecture outline under *Class Materials* might be converted into an interactive information presentation accompanied by audio of the instructor. Various in-class activities, such as worksheets calculating basic descriptive statistics, can also be programmed as an interactive online activity, designed to provide the students feedback as they progress through the activity. One difficulty with such activities, however, is diagnosing student errors and providing sufficient feedback that will benefit the student. Such activities also require a significant amount of time on the part of the faculty member and the web developer to design and contruct.

Assessment

In the same manner that in-class quizzes provided the instructor with feedback on student progress, the online quizzes are also utilized as a method of formative evaluation throughout the semester. Such quizzes do not, however, provide any feedback on student progress after the class lecture and other in-class activities have been completed. One option is to place the quizzes at the end of the unit, after the in-class meeting rather than before. Once the course is converted to be delivered online, this approach may allow the instructor to better monitor student progress that was previously observed in the classroom. The use of an online discussion board as described above would also allow the instructor to monitor students' questions and comments. Students can also interact with the instructor directly through email. Both of these options, however, must be initiated by the student. In many cases, students are hesitant the bother the instructor with a "dumb" question. Building a rapport with the students through some on campus meetings may help to promote more online interaction (Fetterman, 1998).

Summative evaluation of student performance in a web-based course is also likely to differ from traditional assessment procedures (i.e., paper and pencil tests) typically employed in the classroom. This is particular true for statistics classes where the emphasis may be placed on application rather that content acquisition. Objective and short answer tests could be delivered online with the appropriate security precautions, similar to the online quizzes. A disadvantage to this approach, however, is that such assessments essentially become open book exams and may not be an adequate evaluation of student achievement in the course. Exams could be administered on campus, but this would in some ways defeat the purpose of an online course. A more appropriate approach to assessing student performance might be a series of performance tasks, more commonly referred to as authentic assessment tasks. Examples of appropriate tasks for a course in educational statistics and measurement are: a written report presenting the results from an analysis summarizing a small sample data set; constructing and pilot testing an instrument; developing an authentic assessment task within the student's own field of education; and, locating and reviewing a published test. As with any assessment process, such tasks would need to be carefully constructed and well validated.

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Technical Considerations

Based on the developer's previous experience with web development tools, *Microsoft FrontPage 98* was selected as the software tool for developing the course web site. This tool works well for fast development of a web site, and has excellent site management and publishing tools. For future development of more sophisticated interactive elements, other web course authoring tools might need to be considered, such as *Macromedia's Authorware* or *Asymmetrix's Toolbook II Instructor*. For the online quizzes, the developer chose to write a simple CGI (Common Gateway Interface) script using the Perl programming language. However, unless development support is made consistently available to the instructor, a web course development and management system with an automated quiz generation function would be more useful to the instructor for editing and generating online quizzes.

With regards to the design of the web site, a conscious decision was made not to develop a site that was graphic intensive. In order to keep download times to a minimum, no large images or image maps were used. Instead, clip art of about 2K in size was used for icons throughout the web site. This is an important aspect of designing a web site when one considers that not all students may have access to the latest browsers and/or most sophisticated equipment. For example, students with slower modems may become frustrated at the time required for graphic intensive pages to load. Such frustration can have a negative effect on the student's perception of the site and, more importantly, detract from the learning experience.

It is important for developers to keep in mind that there are two target audiences for two distinct types of web sites. The first are those students taking the course campus and utilizing the web site as a source for supplemental activities and materials, such as the site described here. For these students, the technical requirements for accessing the site should be lower (e.g., older browsers should be allowed). For courses that are primarily web-based, students may be required to have the latest browsers or plug-ins, for example, so that more sophisticated types of interactions could be incorporated if needed. Thus, an important part of the development process is recognizing the technical requirements not only for the instructor but for the student as well. Developers need to remember when developing and designing instruction, the use of technology should be secondary to well-designed learning goals and objectives (Berge, 1996).

Evaluation of Web Site

Student Feedback

A brief survey was conducted at the end of the summer to obtain feedback from students enrolled in the course. There were 19 students who completed the course. Of those, 18 completed the survey. Although these numbers are small and have limited generalizability, the results did provide some useful insights into the future development of the web site. Overall student response to the Web Site was very positive Many students were apprehensive at the beginning of the summer session, experiencing what McGonigle and Eggers (1998) describe as the initial stages of confusion and shock students have when taking a web-based course. Once this initial fear was overcome, the majority of students were excited about the web site and found that it enhanced their learning experiences in this course. One student commented, "Please pass the word that the convenience and comfort of the courses on the Internet are exciting!! It can possibly "de-stress" the lives of those of us who have long work hours and family commitments. The ability to access the course work online at my convenience yet with a due date in mind was fabulous!!"

The majority of students indicated that they liked having the course materials available over the internet. As one student stated, "If additional material was needed, it was made available on the web site in a timely manner. I did like the ease with which the material could be down loaded." Some students did experience difficulty down loading the materials. This was partly related to students' inexperience with the computer and the type of materials. (Graphic material and special symbols did not always translate across platforms.) Student responses to the design of the site were also positive and compared favorably to other university course web sites, both in terms of the quality and quantity of materials. Students also liked the images on the Web Site. In some of their written comments regarding the site, students noted that the site "was easy to navigate through" and "very well organized."

Only two students indicated that they did not like taking the quiz on-line. Other students commented that they liked the immediate feedback and would like to see all of the quizzes on-line. The majority of students

also felt an on-line discussion group would be useful. Many felt that it would be helpful to be able to talk with other students, particularly if the instructor was not available or they felt uncomfortable asking the instructor questions. Others felt that access to computers would hinder this and preferred person to person interaction.

Students were also asked if they would prefer an Internet-based course with at least half of the sessions online or a classroom based course. Eleven students preferred the internet course, primarily for reasons of convenience and having to commute long distances. Those students who preferred a classroom based course cited feeling more comfortable with face to face communication and lack of knowledge/experience with the internet and technology.

Conclusions and Recommendations

One approach to converting classroom based courses to be delivered via the Internet, and the one the was adopted here, is to first develop a site that serves as a supplement to the in-class course. Something as simple as an online syllabus can be advantageous for the student and the instructor, where it becomes a gateway for all course information (Mitchell, 1996). The idea of starting with a web site with only supporting materials may work well with faculty who are not familiar with the Internet, or those who do not have the time to embark on a complete conversion of their classroom based course to a web-based one. It allows the faculty member time to get use to using the web with their current familiar classroom materials, rather than having them try to get comfortable with the web at the same time that their course is being redesigned for web delivery using a different model of instruction. A side benefit to this approach is that the instructor is required to thoroughly examine and organize his or her current materials, which may lead to improvements in the classroom based course. Establishing a site as a supplement to the classroom based course may also help students to become more comfortable with the internet. This is an important consideration for programs such as this one where the students are typically older (average age 32) and have limited experiences with the rapidly growing field of instructional technology.

The growth in web-based courses has been quickly followed by an abundance of resources and guides for educator on how to develop such courses (e.g., see Khan, 1997; Porter, 1997; Robin, Keeler & Miller, 1997). The challenge for the individual instructor is apply what can be an overwhelming amount of information to their specific courses. The are several steps that can be taken by universities to support faculty wishing to undertake this endeavor. The first is to provide faculty training. Faculty members need to be aware of what types of technology exist and what university support will be available to them. Some basic faculty training topics related to instructional design and development could be presented in the form of on campus workshops or even as web-based lessons. Providing training online would have the added benefit of allowing faculty to experience web-based instruction.

To ensure consistent and continuous support of faculty for web-based projects, an instructional design team should be created as a permanent university entity. This group would consist of instructional designers/developers who would act as in-house consultants to faculty, providing support for web-based course design and development. This team could be made up of a combination of university instructional design staff and graduate interns from an Instructional Technology program within the university. These "consultants could sit in on lectures, offer advice for more interactivity, think of ideas for work group activities, assist the instructor with creation of presentation materials, or train faculty in the creation of these materials.

Finally, in the commitment to provide students with quality educational experiences through a variety of media, universities must also recognize the support and training students will need to be successful in such courses. Students should have training made available to them on such subjects as how to take an online course, how online courses are different from classroom based courses, what skills are needed to be good online students, etc. Many School of Education programs require students to take a core course in instructional technology. Such a course can serve as a mechanism for providing student with the training and knowledge they need to successful engage in online courses.

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